DESCRIPTION

Refrigeration device with improved condensed water elimination

[001] The present invention relates to a refrigeration device equipped with means for evaporating condensed water accumulating in the device.

[002] The condensed water which accumulates in a refrigeration device at an evaporator used to cool its interior is usually led off via a pipe into an evaporation tray outside the interior of the refrigeration device to be evaporated there and thus released to the ambient air. The evaporation tray is usually mounted on a compressor of the refrigeration device in order to pass the waste heat produced by the compressor during operation into the collected condensed water and thus promote its evaporation.

[003] Optimisation of the energy consumption in modern refrigeration devices has had the result that under unfavourable circumstances, the waste heat delivered by the compressor is no longer sufficient to eliminate the accumulating condensed water. There are various reasons for this, e.g. improved insulation of the refrigeration device which has the result that the switch-on times of the compressor are occupying an increasingly smaller proportion of the total operating time of the refrigeration device, or improvements in the design of the compressor itself, which improve its efficiency and therefore reduce the waste heat capacity available for evaporating the condensed water. In order that the melting water accumulating during defrosting of the evaporator can nevertheless be collected in the evaporation tray, its capacity has been increased considerably.

[004] In addition, there are refrigeration devices such as self-defrosting freezers or no-frost refrigeration devices where condensed water only accumulates in batches but in larger quantities when the evaporator is specifically defrosted. In order to be able to accommodate the quantities of condensed water which can accumulate in such a refrigeration device under all circumstances, a large evaporation tray is required whose space requirement is at the expense of the useable interior space for pre-determined external dimensions of the refrigeration device.

[005] It is thus the object of the invention to provide a refrigeration device with which it is possible to eliminate larger quantities of accumulating condensed water in a space-saving manner and with minimal energy expenditure.

[006] The object is solved by connecting a vaporiser to a collection device for condensed water provided in the refrigeration device, which serves to release the condensed water in the form of extremely fine droplets to the ambient air. These droplets extract the thermal energy required for their complete evaporation from the ambient air and thus do not affect the energy balance of the refrigeration device.

[007] This vaporiser is preferably disposed above a collecting tray which is capable of collecting droplets produced by the vaporiser which are too large for immediate vaporisation.

[008] The collection device is further preferably connected to an evaporator tray heated by a compressor. More appropriately, this evaporation tray can be arranged as an intermediate storage device from which the vaporiser is supplied with water.

[009] Such an evaporation tray can more appropriately simultaneously form the afore-mentioned collection tray for droplets produced by the vaporiser.

[010] As a result of a first embodiment of the invention, the vaporiser comprises a vaporiser nozzle and a pump for pressing the condensed water through the vaporiser nozzle.

[011] This can comprise an electrically driven pump, especially a pump comprising a linearly movable piston and a solenoid displaceable in a coil for driving the piston.

[012] The pump can also be driven by opening and/or closing a door of the refrigeration device, a direct mechanical coupling of the pump to the movement of the door for driving the pump being considered in this case.

[013] As result of a further development of the invention, a high-frequency oscillator, especially an ultrasonic oscillator can be used for vaporising the condensed water.

[014] It is also appropriate to provide a sensor for detecting a collected quantity of condensed water and a control device for operating the vaporiser when the collected quantity of condensed water detected exceeds a limiting value.

[015] Further features and advantages of the invention are obtained from the following description of exemplary embodiments with reference to the appended figures. In the figures:

[016] Fig. 1 is a schematic section through a refrigeration device according to the invention;

[017] Fig. 2 is a schematic section through a pump vaporiser of the refrigeration device from Fig. 1; and

[018] Fig. 3 is a detail of the refrigeration device according to the invention with an ultrasonic oscillator.

[019] The refrigeration device shown schematically in cross-section in Fig. 1 comprises a heat-insulating housing comprising a casing 1 and a door 2 hinged thereon, enclosing an interior 3. An evaporator 5 is located on the back of the interior 3 which is subdivided into compartments by a plurality of shelves 4. The evaporator 5 is shown here as a plate-shaped member inserted between a wall of the insulating container of the casing 1 which defines the interior 3 and a heat insulating material 6. A coolant circuit extends from a high-pressure output of a compressor 7 via a condenser 8 attached externally to the back of the casing 1 and the evaporator 5 to a suction connection of the compressor 7. The compressor 7 is accommodated in a niche 9 near the bottom at the back of the casing 1 below the evaporator 5.

[020] Air moisture from the interior 3 which condenses on its wall cooled by the evaporator 5 collects at the lower edge of this wall in a drainage channel 10 and from there, via a drain pipe 11 passing through the heat-insulating material 6, reaches an evaporation tray 12 which is mounted on the compressor 7 to be heated by its waste heat.

[021] A suction connecting pipe 13 of a pump vaporiser 14 dips into the evaporation tray 12. The structure of the pump vaporiser is described in further detail hereinafter with reference to Fig. 2. Above the evaporation tray 12 this produces a fine mist from its sucked-in condensed water whose droplets rapidly evaporate as a result of their small size. The air moisture produced in the niche 9 is flushed away by an air flow which, driven by that from the condenser 8 in a flue between the rear wall of the casing 1 and an opposite furniture or building wall not shown, initially runs along a suction channel 15 guided along the underside of the casing 1, then through the niche 9 and finally via the flue into the open air.

[022] Figure 2 shows an example of a possible structure of the pump vaporiser 14. The suction connecting pipe 13 opens into a pump chamber 16 in which a piston 17 can move to and fro. When the piston 17 is at rest, a check valve is closed, this being shown here as a ball 18 which is held pressed against a valve seat 20 at the inlet of the pump chamber 16 by a leaf spring 19.

[023] In the piston 17 a pipe 21 extends from the pump chamber 16 to a vaporiser chamber 22 in which the incoming condensed water is vigorously agitated before it passes into the open through a fine nozzle orifice and there vaporises to form a mist 23.

[024] The piston 17 can be displaced by means of a magnet 25 which is held movably in a coil 24 supplied with current. When the coil 24 is supplied with current in a suitable direction so that the magnet 25 drives the piston 17 into the pump chamber 16, towards the right in the figure, a high pressure is built up in the pump chamber 16, with the result that water flows through the pipe 21 and vaporises.

[025] When the magnet 25 is moved to the left, a compression spring 26, shown here as a helical spring surrounding the pump chamber, drives the piston 17 outwards so that the check valve opens and fresh water is sucked in via the suction connecting pipe 13. Thus, with each movement cycle of the magnet 25, a quantity of water corresponding to the stroke of the piston 17 is vaporised.

[026] As a result of a modification not shown, the piston 17 and the magnet 25 are rigidly connected or constructed in as one part. In this modification, the compression spring 26 can be omitted because the magnet 25 is also capable of driving the movement of the piston 17 out from the pump chamber 16. During the movement of the piston 17 into the pump chamber 16, no counter-force of the compression spring 26 therefore needs to be overcome and the pressure which can be built up in the pump chamber 16 is enlarged for the same design and current flow through the coil 24.

[027] A control circuit can be provided which in each case after a pre-determined time interval, supplies the coil 24 with current to drive one or more movement cycles of the magnet 25. As a result of a further development, this control circuit detects or controls the operation of the compressor 7 and actuates the pump after a certain time interval has elapsed only when the compressor is operating or has run for a certain time to ensure that the vaporised water is immediately removed from the afore-mentioned air flow.

[028] The control circuit can also be coupled to a movement of the door 2 in order to detect this and, instead of after a pre-determined time interval, in each case after a given first number of door opening or closing processes, to drive a second given number of movement cycles of the magnet 25.

[029] As a further alternative, a water level sensor can be provided on the evaporation tray 12, which delivers a signal indicating whether the water level in the tray 12 has exceeded a pre-determined limit or not and the control circuit drives the to-and-fro movement of the magnet 25 for as long as the detected water level lies above the limit.

[030] As a consequence of a further modification, the coil 24 and the magnet 25 can be replaced by a lever mechanism which is coupled to a movement of the door 2 and which, for example, can extend through the suction channel 15. Thus, every time a user opens and closes the door 2, he simultaneously drives a movement cycle of the piston 17.

[031] Figure 3 is a schematic section through an evaporation tray 12 mounted on a compressor 7 according to a second embodiment of the invention. Located on the surface 27 of the water collected in the tray 12, is an annular float 28 which holds an ultrasonic generator 29 at a fixed short distance below the surface of the water 27. The ultrasonic generator 29 is of a known type such as is generally used in air humidifiers. It acts as a vaporiser by delivering ultrasonic energy to the water located thereabove, with the result that a mist of fine droplets rises from the surface of the water surrounded by the annular float 28.

[032] The unit comprising float 28 and ultrasonic generator 29 is held on a pivoted arm 31 connected to a switch 30. When the water level rises above a given limit, the switch 31 closes and supplies the ultrasonic generator 29 with energy until the water level has fallen below the limit again. As long as the water level is low, only the waste heat of the compressor 7 is used to evaporate the collected condensed water. Only when the water level reaches a critical level, is the ultrasonic generator 29 switched on to support the evaporation and eliminate any overflow of the evaporation tray 12.

[033] The float 28, the pivoted arm 31 and the switch 30 form a water level sensor which can be used without the ultrasonic generator as the water level sensor mentioned in conjunction with Fig. 2.